

## Aspects of the Brazilian economy and politics

Brazil is among the largest countries of the world by its area (5th position after Russia, Canada, USA, and China), as well as by its population (also 5th position after China, India, USA, and Indonesia). Its National Gross Product is about 700 billion dollars, which places Brazil among the 10 largest economies (the ranking depends on the currency exchange rate). Although the population growth was fast in the past, it is now only about 1.4 % per year (in 2000), and the population growth rate is still decreasing.

Brazil is a democracy with presidential regime, and is quite stable from the political point of view. Executive, legislative, and judicial powers are separated. Brazil is divided in 26 States, each having an elected governor. Suffrage is universal.

Presently the leftist PT (Party of the Workers) detains the federal power, but it follows basically the same strict economical rules of the previous government, keeping inflation under control and working towards reducing poverty. Brazil has never suffered any big political traumatism or war in its history. The relationship with neighboring countries is excellent. Although it has multi-cultural and multi-racial origins, it is remarkably homogeneous over its territory from linguistic and cultural points of views. No conflicts between ethnical or religious groups, or reasons for terrorism, can be foreseen. There are Indian reserves in Brazil, but far from the places that are being proposed for SKA.



*Map of Brazil showing its 26 states.*

The economy is strong and diversified, possessing large and well-developed agricultural, mining, manufacturing, and service sectors. Modern industries are installed in Brazil, like all the major car, truck, and bus fabricants (Fiat, Volkswagen, Ford, General Motors, Renault, Peugeot, Citroen, Honda, Toyota, Mercedes-Benz, Scania-Vabis, Volvo, and others- total 2 million cars produced in 2005), as well as computer and cellular phone companies, airplane and helicopter industries. The airplanes from Embraer are internationally competitive and are flying all over the world. Brazil exploits the deepest off-shore petroleum reserves, and is now self-sufficient in oil production. There is a strong production of steel, aluminium, tin, iron ore, paper, chemicals, machinery, shoes, and textile products. The production of agriculture is the first or second in the world ranking for many products like soybeans, corn, sugar, coffee, cocoa, and orange juice. Brazil is now the first exporter of beef and of chicken. The construction of the city of Brasilia and the power plant of Itaipú, are examples of the civil engineering capability. The services are well developed and efficient. The bank agencies are interconnected all over the country, so that one can use automatic teller machines to access an account thousands of kilometers away. Brazil is probably the only country in the world where the elections for president, state governors or other levels are entirely electronic, and the results of an election are known by the end of the day of voting.

Successive governments have focused on the long term goal of reducing poverty, income inequality, and regional differences, which are considered as the main problems of Brazilian economy. The illiteracy affects about 12% of the population and is mostly concentrated in the States of the North-East.

### **The scientific environment**

In Brazil, research is supported by the federal agency Conselho Nacional de Pesquisas (CNPq) founded in 1951, an agency that is now part of the Ministry of Science and Technology. The CNPq grants Ph.D and postdoctoral fellowships as well as research grants. The State of São Paulo, through the Foundation for the Support for Research (FAPESP), distributes about US \$ 400 million annually in the form of fellowships and research grants. Brazil is at present awarding about 1 billion dollars in fellowships for Master in Science and Ph. D students. About 9500 Ph.D theses are being concluded in 2005, and 10600 will be concluded in 2006. This means that the target of the present government of 10 000 PhD theses per year has been reached. Brazil is the 17<sup>th</sup> in the ranking of scientific production in the world, but this position is improving; the rate of increase in the number of published papers is about 15% per year.

The plans of Brazil are ambitious, with its 1.4-GeV synchrotron light source, and state of the art facility for protein crystallography and the successful multimillion project that lead to the unveiling of the full genome sequence of the citrus pathogen *Xylella fastidiosa* and other genomes. This project is revolutionizing Molecular Biology in Brazil and will, of course, greatly benefit Physiology. In São Paulo, science has been favored with a budget of 1% of the total state budget, which is handled by committees of scientists. Rio

de Janeiro, Minas Gerais, Rio Grande do Sul are among the States that also have a high concentration of first class scientists and have State research foundations. In the last 2 years, research foundations similar to FAPESP have been created in several other States.

### **Brief Overview of Astronomy in Brazil**

Official astronomical activities in Brazil date to 1827 with the creation of the National Observatory in Rio de Janeiro, although earlier astronomical observations have been reported during the Dutch occupation in northeastern Brazil in the beginning of the seventeenth century. Modern astronomy activities have started in the State of São Paulo early in the 20<sup>th</sup> Century with the foundation of the São Paulo Observatory – later on renamed as Instituto Astronômico e Geosférico (now Instituto de Astronomia, Geofísica e Ciências Atmosféricas) and now part of the University of São Paulo. The Federal universities of Minas Gerais and of Rio Grande do Sul and Rio de Janeiro states also have tradition in astronomical research and run observatories for about half a century or more.

The main astronomy centers in Brazil are:

IAG/USP The Institute for Astronomy, Geophysics and Atmospheric Sciences, at the University of Sao Paulo  
INPE. The National institute for Space research, São José dos Campos, São Paulo State  
ON – Observatório Nacional, Rio de Janeiro  
Federal University of Rio Grande do Sul State (Porto Alegre)  
Federal University of Rio de Janeiro State (Rio)  
Federal University of Minas Gerais (Belo Horizonte)  
Federal University of Rio grande do Norte State (Natal)  
LNA-National Laboratory of Astrophysics, Itajubá, Minas Gerais  
CRAAM- Mackenzie University, São Paulo

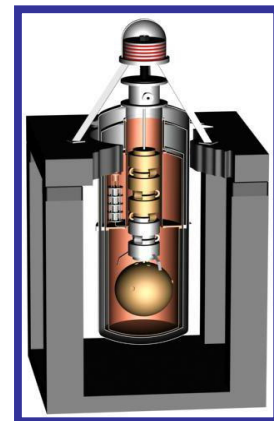
Astronomical research in Brazil has received a great impulse in the 70's thanks to some programs developed by Brazilian agencies aiming at the formation of PhDs abroad and with the return to the country of several young researchers. From this time on, they started working on the formation of a new generation of astronomers. This phase of the Brazilian Astronomy was also marked by the coming into operation of several 60 cm telescopes, the 13.7 m radiotelescope at Itapetinga, and the 1.6m National Optical Telescope.

The Brazilian Astronomical Society (SAB) was founded in 1974 and since then it has organized annual meetings which offer the opportunity to astronomers, especially students and Post-Docs, to present the results of their investigations. The Society has been giving support to Symposia and workshops. Presently SAB has 520 members, 320 of them holding a PhD degree, most of the others being PhD students. The SAB annual meetings typically are attended by 300 participants (330 in 2003). Since early 80's, 7 IAU Symposia and 2 IAU Latin America Regional Meetings, were held in Brazil. Among

recent symposia or workshops, there was the IAU 198 Symposium “Light Elements and their Evolution” held at Natal in 1999 November, the IAU 206 Symposium “Cosmic Masers” held at Rio de Janeiro in 2001, the IAU 222 Symposium “Interplay among Black-Holes, Stars and ISM in Galactic Nuclei” held at Gramado in 2004 March, the International Meeting on Instrumentation for large Telescopes held at Angra dos Reis in 2003 November, the Colloquium “Open issues on Local Star Formation” held at Ouro Preto in 2003 April, the Symposium “Magnetic Fields in the Universe” held at Angra dos Reis in 2004, the IAU Symposium 229 “Asteroids, Comets and Meteors” held in 2005 at Buzios, RJ. The 2009 IAU General Assembly will take place at Rio de Janeiro.

In the last decade, Astronomy in Brazil has experienced a major development. Among all scientific areas, it has presented the third more important increase in the number of scientific publications and PhD theses. The Brazilian relative participation in the International Astronomical Community has also increased significantly. In the last years Brazil has been also forming PhD astronomers from Argentina, Chile, Colombia, Peru, Uruguay, and hosting post-doctoral fellows from all over the world. Recently Brazil entered in a new phase, thanks mostly to its participation in the Gemini and SOAR projects. The 4.2m SOAR telescope, dedicated in April 2004, of which Brazil has 30% of the observing time, was built near Gemini South. Brazil is strongly involved in the development of instruments for SOAR.

A number of achievements of the Brazilian astronomy are shown in the following figures.



*The gravitational waves telescope Schemberg (collaboration between INPE and USP)*



*The MASCO X-Ray  
balloon-borne telescope at  
INPE*

### **A brief overview of Radio-Astronomy in Brazil**

Radioastronomy had a strong increase in scientific production after the installation of the Itapetinga 14 m radiotelescope in 1972, by the CRAAM (now operated by INPE). Solar research, and Galactic and extra-galactic were competitive in the 1970 decade. The discovery and investigation of many H<sub>2</sub>O and SiO maser sources, including the first extragalactic megamaser, were reported. Variability of quasars and other radio-sources was another line of research. A number of VLBI experiments in conjunction with Northern observatories were performed. There are now plans to install a focal plane array at the focus of the radiotelescope.

More recently several new groups appeared, mostly at INPE. A small sub-millimetric telescope for solar observations is being operated by CRAAM at El Leoncito, in Argentina. A Decimetric Array is being constructed by INPE at Cachoeira Paulista (São Paulo State), in collaboration with India. A first group of antennas were tested at the São José dos Campos headquarters and have been transferred to Cachoeira Paulista, where fringes have already been obtained. The plan is to increase the number of antennas to 32 in 3 years; the 4 m dishes are made in Brazil. Another group is mapping the whole sky at several frequencies (the GEM experiment) in order to remove the galactic background from the cosmic background.





*The Itapetinga 14m telescope during the change of radome*



*The SST at El Leoncito*

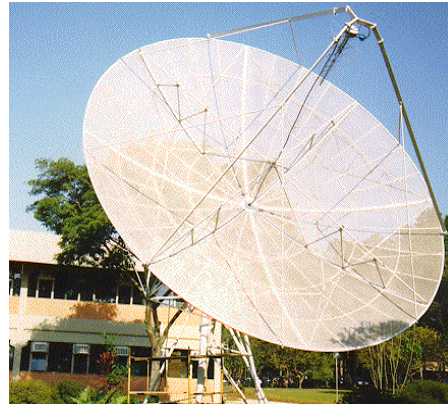


*The GEM experiment  
(5.5 m fast spinning antenna)*



*The BDA (Brazilian  
Decimetric Array)  
before being  
transferred to  
Cachoeira Paulista*

*The 9 m solar spectrograph at INPE*



**Table X:** Radiotelescopes operated by Brazilian institutions

Site	Location	Lat/ Long/ Alt.	Oper.	Frequency	Sensit	BW	Type			Application
							Cont	Line	VLBI	
ROI	Atibaia-SP	23 11 05 S 46 33 28W 805 m	1973m ain power connec tions in the region of interest	10-50 KHz	0.1		X			Ionosphere
				6-7 GHz	0.1	1G	X			Sun
				11-13 GHz	10	1G	X			Sun
				18-24 GHz	0.001	1G	X	X		Sun and gal.
				21-24 GHz	0.001	1G	X	X		Sun and gal.
				32-37 GHz	0.001	1G	X	X		Sun and gal.
				40-44 GHz	0.001	1G	X	X		Sun and gal.
				45-50 GHz	0.001	1G	X	X		Sun and gal.
80-100 GHz	0.001	1G	X	X		Sun and gal.				
ROEN	Euzébio- CE	03 52 39 S 38 25 34W	1990	2-3 GHz	0.001	500M	X		X	Gal. and
				8-9 GHz	0.001	1G	X		X	Extra gal.
BSS	S.J. Cam- pos – SP	23 12 29 S 45 51 35 W	1990	1-2.5 GHz	10	3M	X	X		Sun
BDA	C. Paulis- ta - SP	22 41 13 S 44 59 07 W	2003	1-5 GHz	0.001	2.5M	X	X		Sun and gal.
GEM	C. Paulis- ta - SP	22 41 13 S 44 59 07 W 621 m	1998	408 MHz	10	80M	X			CMB
				1.465 GHz	1	300M	X			
				2.3 GHz	1	300M	X			
				5 GHz	1	500M	X			
				10 GHz	1	500M	X			
BEAST	Balloon SP-MT	40 km	2004	30-31 GHz	0.001	1G	X			CMB
				38-46 GHz	0.001	1G	X			
				90-91 GHz	0.001	3G	X			
				150-151 GHz	0.001	3G	X			
				300-301 GHz	0.001	3G	X			